European Gravity Service for Improved Emergency Management

a new Horizon2020 project to serve the international community and improve the accessibility to gravity field products

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Introduction

A proposal for the project

EGSIEM European Gravity Service for Improved Emergency Management

has been submitted last spring to the EO-1 Space Call of the Horizon 2020 Framework Program for Research and Innovation.

EGSIEM project overview (1)

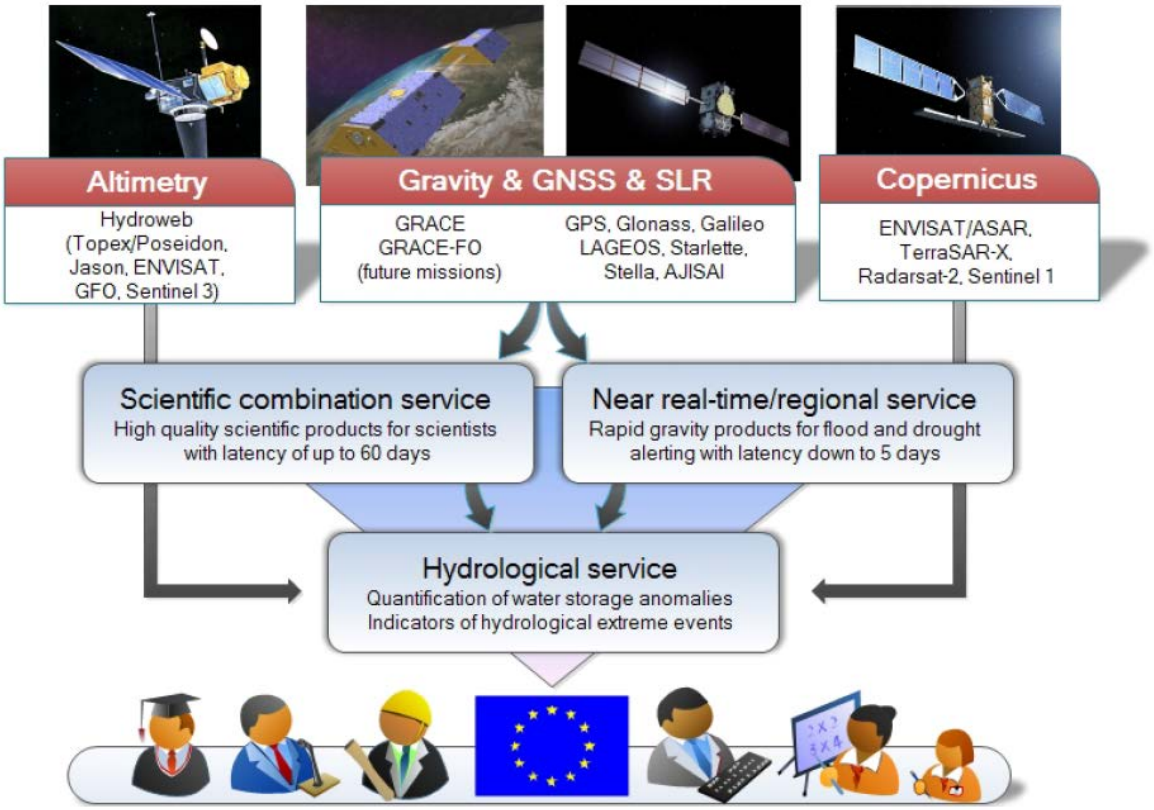
The Grant Preparation with the European Commission has been successfully completed last year and EGSIEM has officially started on January 1, 2015.

The three main objectives of EGSIEM are to

- **deliver the best gravity products for applications in Earth and environmental science research**
- **reduce the latency and increase the temporal resolution of the gravity and therefore mass redistribution products**
- **develop gravity-based indicators for extreme hydrological events and demonstrate their value for flood and drought forecasting and monitoring services**

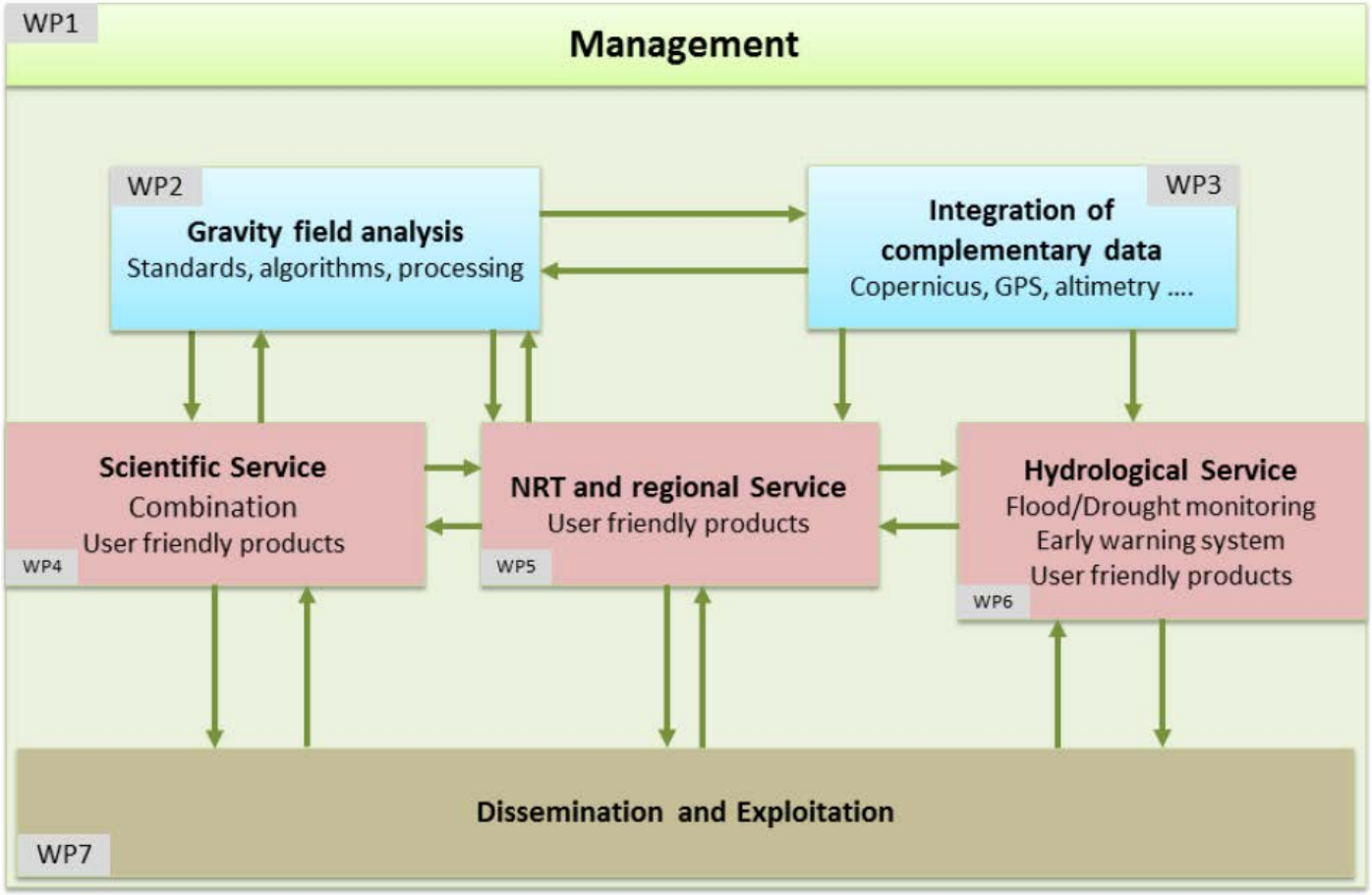
EGSIEM project overview (2)

- **Three dedicated services shall be established**



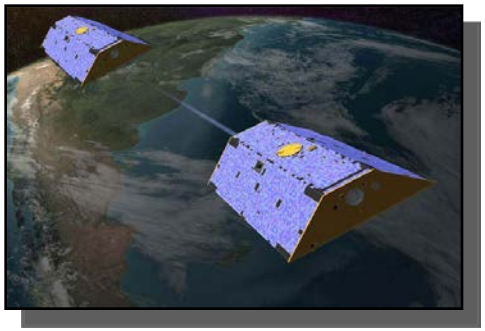
Services will be tailored to the needs of governments, scientists, decision makers, stakeholders and engineers. Special visualisation tools will be used to inform, update, and attract also the large public.

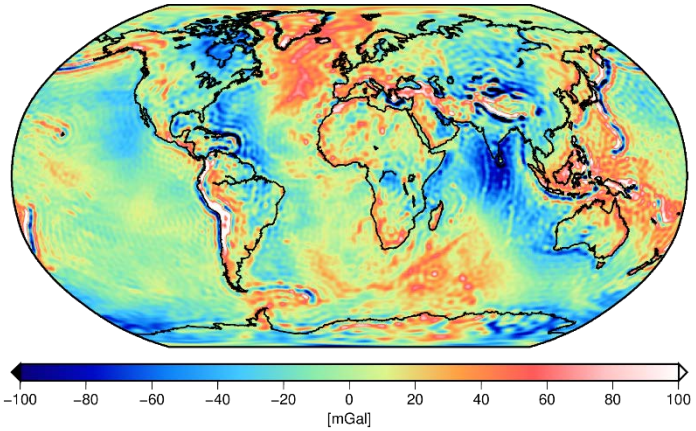
EGSIEM project overview (3)



The used input data sources and the anticipated services that shall be established are reflected in the EGSIEM WP structure.

WP2: Gravity Field Analysis





Improved gravity field solutions by:

- Harmonization of processing standards
- Improvements of analysis methods
- Error analysis with End-to-End simulator

EGSIEM Analysis Centers (ACs):

- **GFZ** (Direct Approach)
- **CNES** (Direct Approach)
- **AIUB** (Celestial Mechanics Approach)
- **ITSG** (Short-Arc Approach)
- **University of Luxembourg** (Acc. Approach)
- **More in the future …**

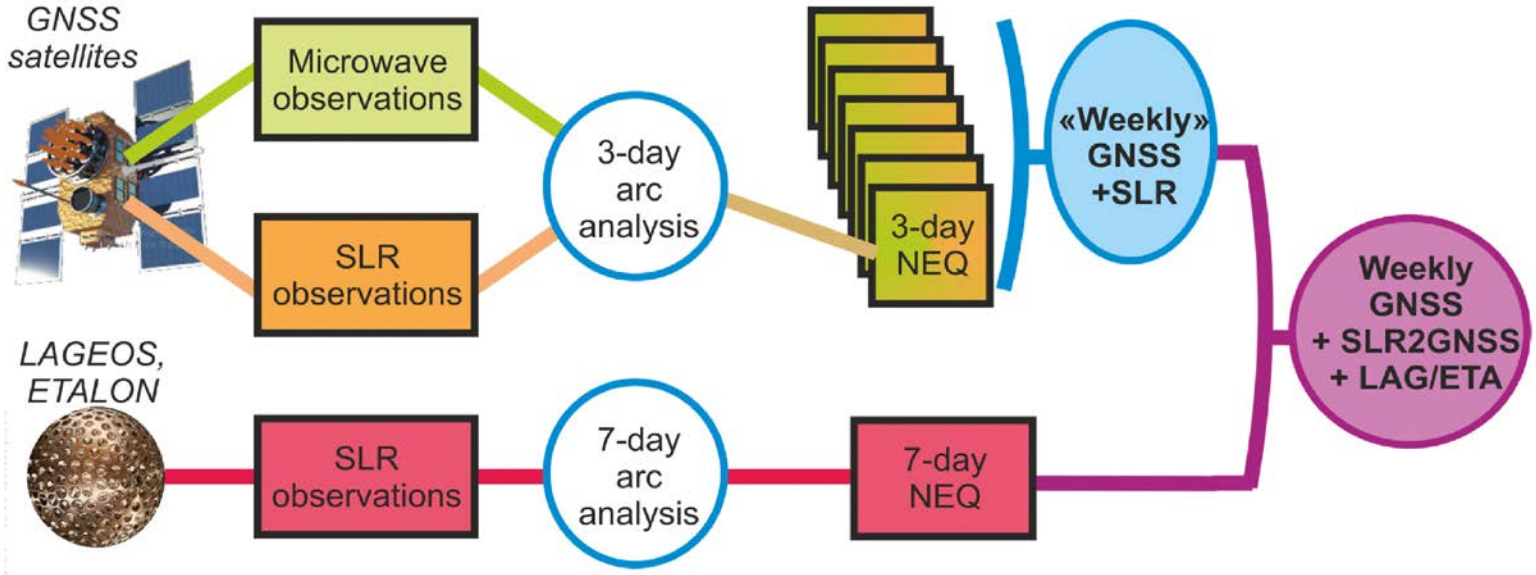
=> Provide different solutions for the combination in WP 4

WP3: Integration of complementary data (1)

Data	Application
GNSS	Reference frame
SLR	Reference frame + gravity
GNSS loading	Validation
Ocean bottom pressure	
Altimetry data (lake and river levels)	Integration into hydrological service (and validation)
GIA models	Separation of GIA-related trend from hydrological trend (where necessary)
Historical flood situations	Validation of GRACE derived flood and drought indices

WP3: Integration of complementary data (2)

- **Consistent reference frame for all products**
- **Linking geometry (GNSS) and gravity (SLR)**
- **Degree 1 coefficients from SLR directly incorporated**
- **NRT service requires NRT reference frame**



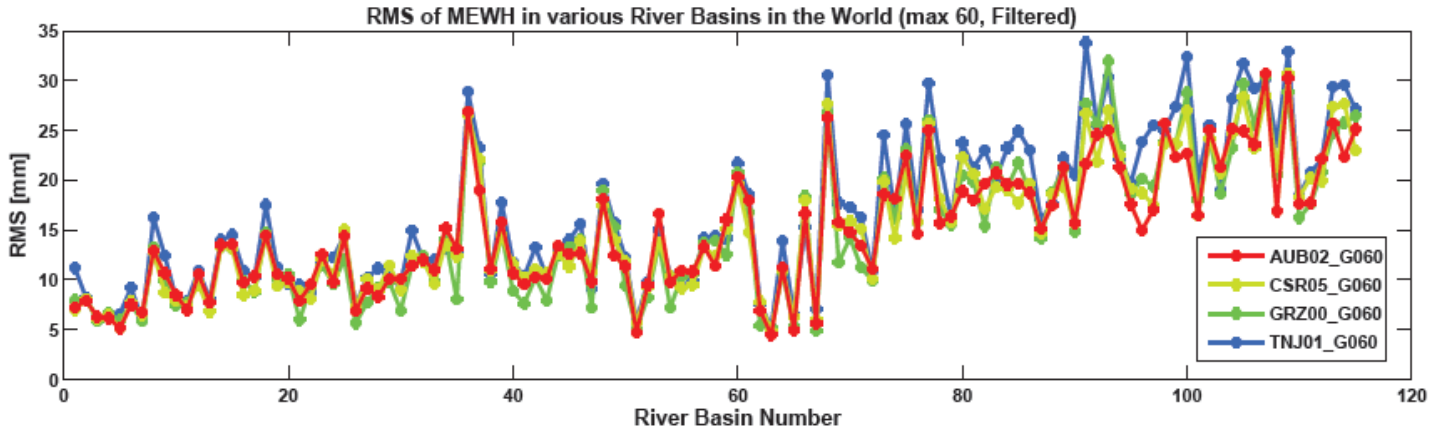
WP4: Scientific Service (1)

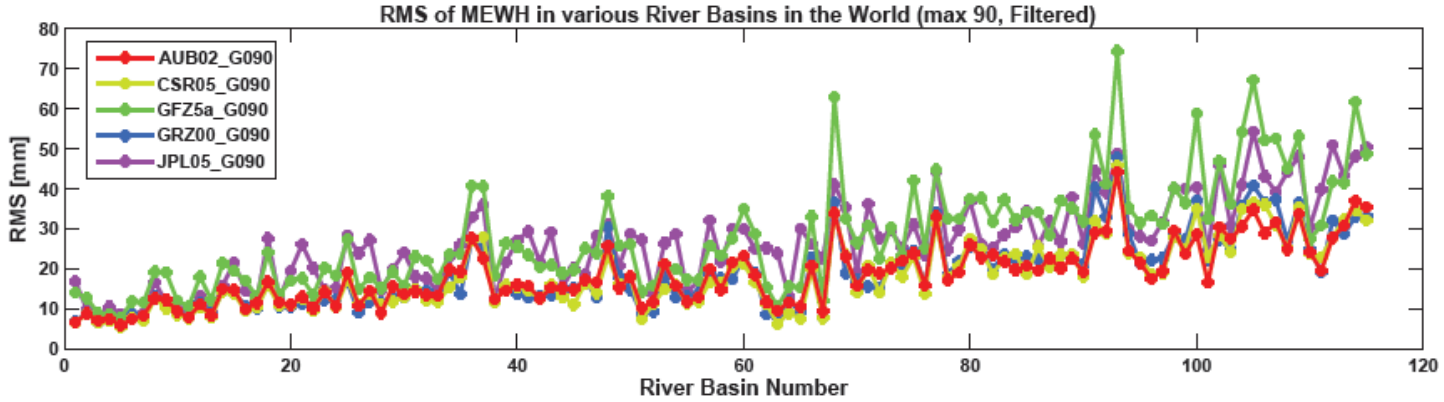
Adopting rigorous and independent processing approaches, each AC will deliver consistent gravity field solutions. For the first time, a meaningful combination by the Analysis Center Coordinator (ACC) will be possible. This task will be coordinated by AIUB, it includes

- **Comparison of the AC solutions, identification of gross errors**
- **Pair-wise comparison of gravity solutions to approximate empirical weights for the individual ACs**
- **Combination of all AC solutions to generate combined solutions using the following two schemes:**
  - **Calculate weighted averages based on the empirical weights**
  - **Determine the combined solution based on a combination of normal equations (NEQ) generated by the individual ACs**
- **Provide suitable products for hydrological and geophysical applications from the combined and individual AC products**

WP4: Scientific Service (2)

Solution comparison and combination:



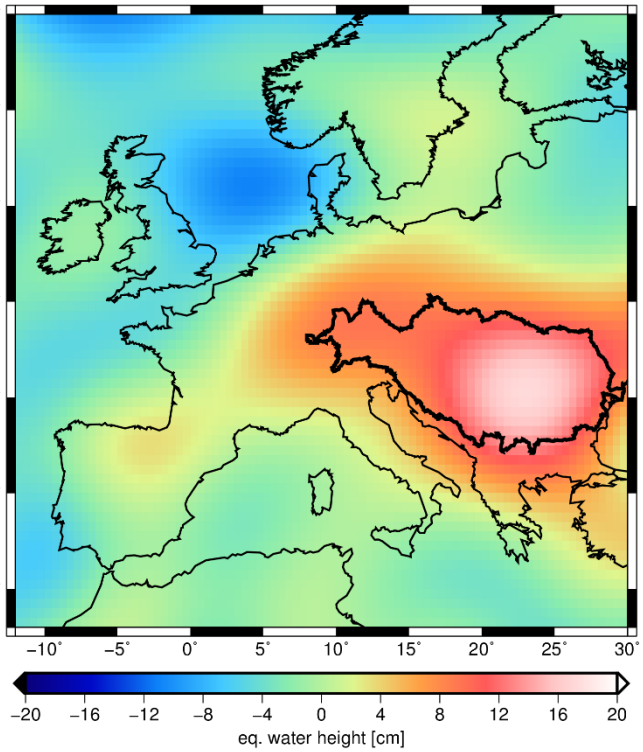


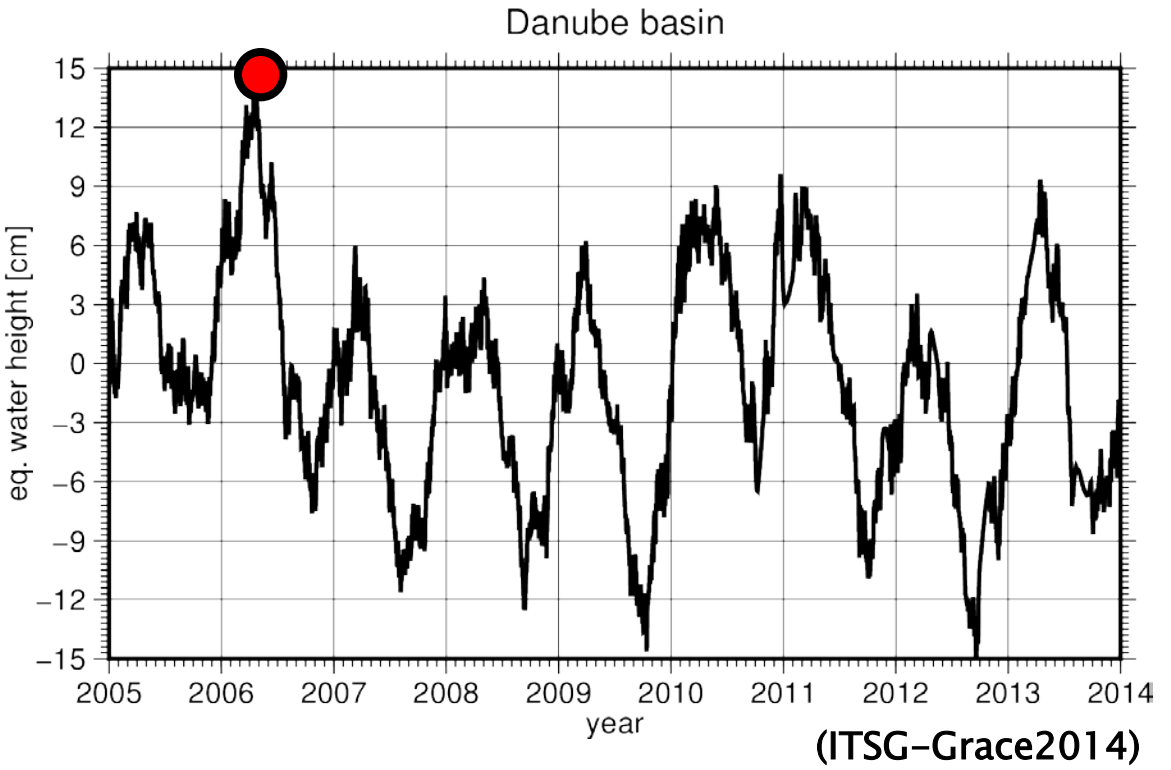
For more details, see poster G348 by Jean et al.

WP5: Near real-time and regional service

Daily updated solution (Near real-time with max. 5 days delay)

- **ITSG: Kalman filtered solutions**
- **GFZ: Alternative representations (e.g., radial basis functions)**

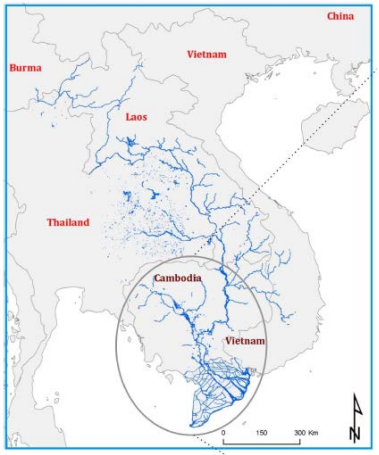


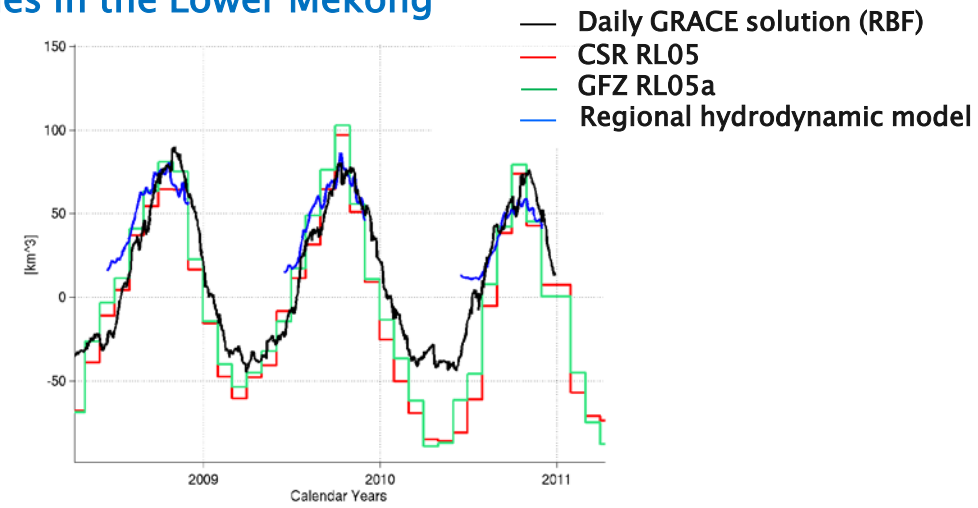


WP6: Hydrological Service (1)

- **Gravity-based flood and drought indicators as descriptors of the integral wetness status of river basins**
  → early warning for hydrological extreme events

Flood volumes in the Lower Mekong





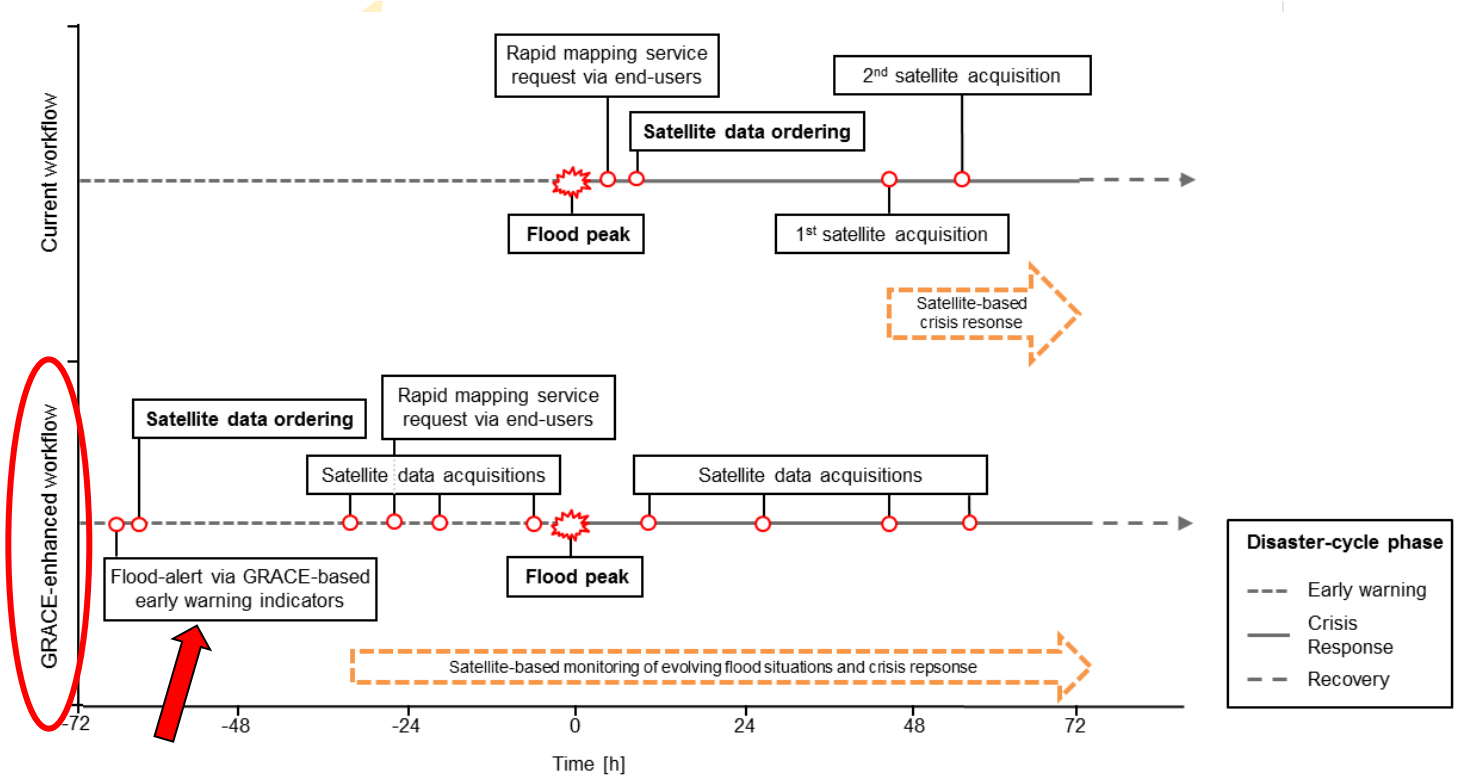
- **Testing the added value of gravity-based indicators at different lead times (several months to near real time)**

  - via assimilation into flood forecasting models

  - in statistical forecasting approaches

WP6: Hydrological Service (2)

- **Improved rapid mapping by on-demand programming of satellite acquisitions**
- **Integration into automatic flood emergency management services**



WP7: Dissemination and Exploitation (1)

EGSIEM will have an open data policy with respect to all data generated within the project. Accessibility to all levels will be guaranteed via the project website:

www.egsiem.eu

A central component of the EGSIEM dissemination activities will be the EGSIEM plotter, which allows easy data access and visualization.

WP7: Dissemination and Exploitation (2)

EGSIEM Visualization Tool: Extension of The GRACE Plotter, developped by Géode & Cie for CNES.

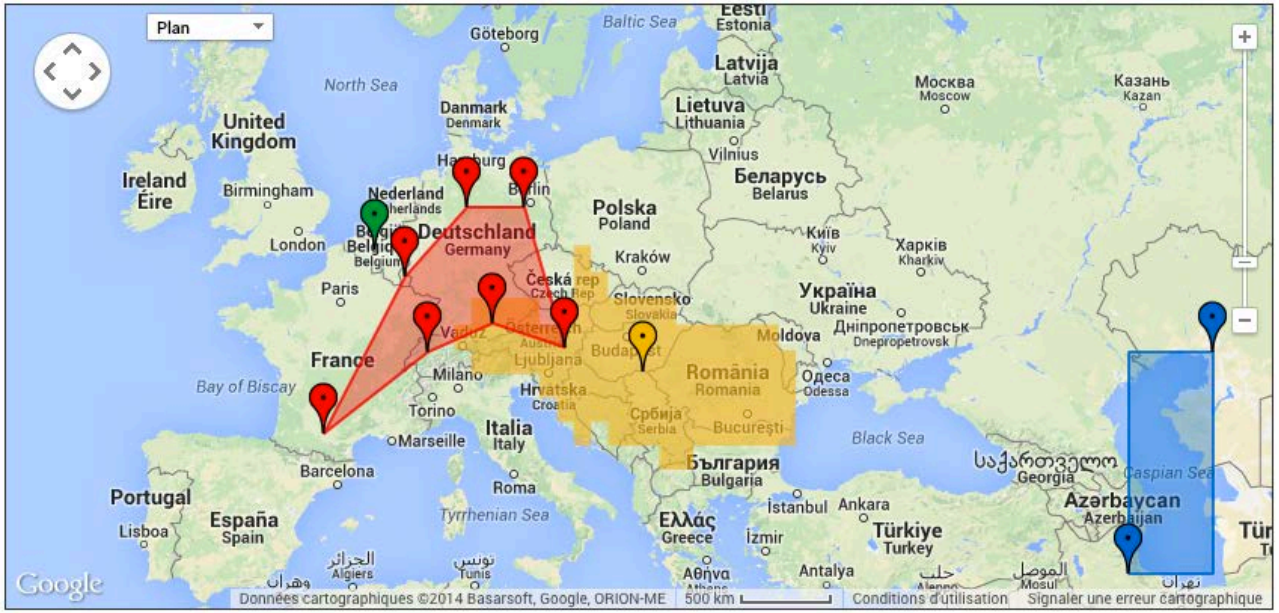
Data selection

center, type, version…

Multiple possibilities for extraction areas, custom or predefined

Interactive plots

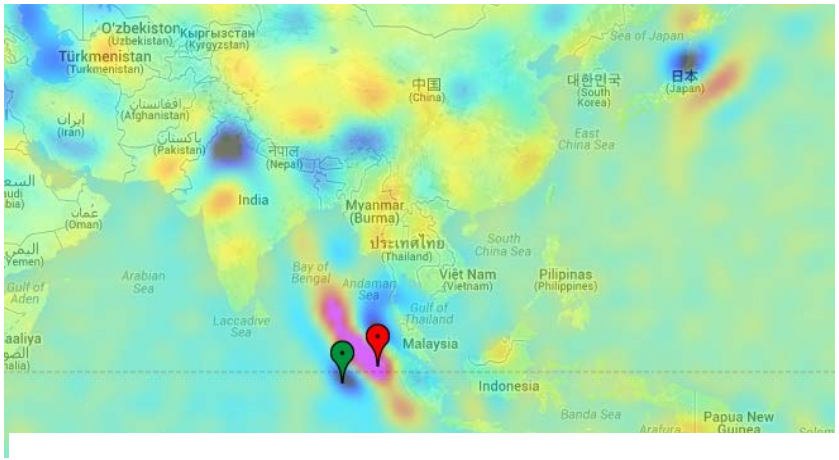
Series title	Data center	Version	Area	Address	Latitude	Longitude	Apply
Series 1	CNES/GRGS	RL03-v1	7-Heptagon	Bern, Switzerland	46.947922	7.444608	All
				Oberpfaffenhofen, Germa	48.074400	11.262200	
				Graz, Austria	47.070714	15.439504	
				Potsdam, Germany	52.390569	13.064473	
				Hannover, Germany	52.375892	9.732010	
				Luxembourg	49.815273	6.129583	
				Toulouse, France	43.604652	1.444209	
Series 2	GFZ	RL05-DDK5	Point	Brussels, European Comm	50.842317	4.370471	All
Series 3	CSR	RL05-DDK5	Danube	Danube basin	46.121053	19.994737	All
Series 4	JPL	RL05-DDK5	Rectangle	Iran, Province d'Ardabil	37.385404	48.373454	All
				Kazakhstan, District de Jy	46.937235	53.227348	

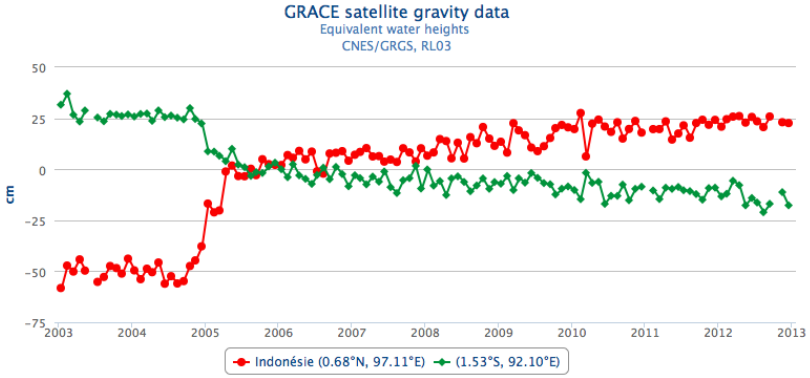


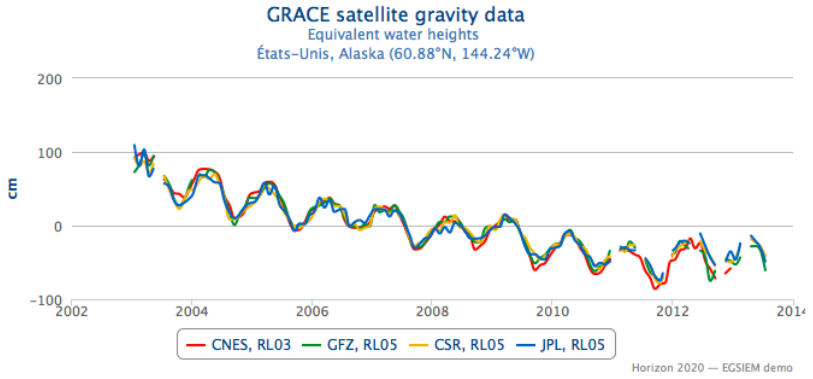
WP7: Dissemination and Exploitation (3)

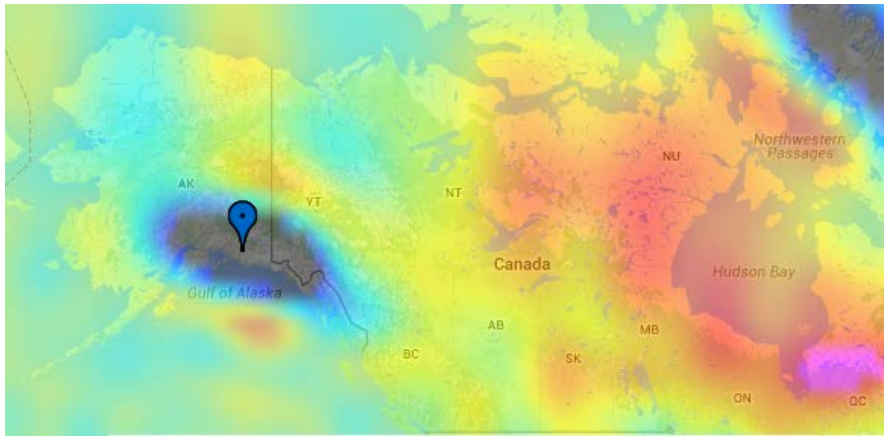
géode&cie

EGSIEM Visualization Tool: Interactive, fast and user-friendly visualization of results for scientific evaluation.









Summary and Outlook

- EGSIEM will run for three years (2015–2017)
- Three different services shall be established:
  - a scientific combination service
  - a near real-time (NRT) / regional service
  - a hydrological/early warning service
- Future integration into the services of the International Association of Geodesy (IAG), e.g., under the umbrella of the International Gravity Field Service (IGFS), and into the Copernicus emergency service is envisaged
- EGSIEM will have an open data policy and is open for collaborations with further partners.

Keep in touch

Newsletter

No. 1
April 2015

EGSIEM

European Gravity Service for Improved Emergency Management

Inside this issue:

Courtesy NASA/JPL Caltech

WELCOME TO EGSIEM

The **European Gravity Service for Improved Emergency Management (EGSIEM)** project, which is funded by the Horizon2020 Framework Program for Research and Innovation of the European Union, aims at using gravity field analysis for forecasting and mapping of hydrological extremes like large-scale droughts and flood events. The project is funded for three years, from 2015 to 2017. The leader of the project is the Astronomical Institute of the University of Bern.

EGSIEM CONSORTIUM

- Universität Bern, Switzerland
- Université du Luxembourg, Luxembourg
- Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum, Germany
- Technische Universität Graz, Austria
- Leibniz Universität Hannover, Germany
- Centre National d'Études Spatiales, France
- Deutsches Zentrum für Luft- und Raumfahrt e.V., Germany
- Géode & Cie, France

Photo: M.Tognola
EGSIEM kick-off meeting, 13.-14.January 2015, Bern

Goals and Ambitions

At the heart of the EGSIEM project is the idea that *better knowledge yields better decision-making.* Towards this idea the 8 consortium members of EGSIEM aim to derive improved products from the **Gravity Recovery and Climate Experiment** (GRACE) satellite mission. The current latency and complex nature of the data derived from the GRACE mission (a dual satellite mission of NASA and the German Aerospace Center, which has been making detailed measurements of Earth's gravity field variations since March 2002) makes the data of limited value for monitoring and forecasting applications. Currently Geodesists need to wait approximately 2 months from observation by GRACE until the data is processed for access and examination. EGSIEM will improve the data latency, will perform the complex processing, and will provide a simple to use web interface (based on the ***EGSIEM plotter*** provided by Géode & Cie). The data will be freely available for users.

The impact of EGSIEM

The main goal of the project is to improve the availability of data for users, especially in terms of better drought and flood forecasting. EGSIEM will reduce the timeframe to 5 days. As the data is going to be made freely available (via our project website egsiem.eu), the users may use them also for other applications as well. EGSIEM aims to improve existing monitoring products. The improvement in flood and drought monitoring will benefit Europe and also other countries. For example the impact of the 2009 flood in Namibia which claimed 131 lives and displaced 445,000 people could have been better anticipated by the existence of concise warning products.

News and updates will be regularly published on various media, e.g., by the quarterly EGSIEM Newsletter.

The first issue can already be accessed at

www.egsiem.eu

EGSIEM is also present on social media:

https://twitter.com/EGSIEM

www.facebook.com/egsiem

https://egsiem.wordpress.com

Keep in touch

Thanks a lot for your attention!

The EGSIEM consortium is looking forward to your feedback